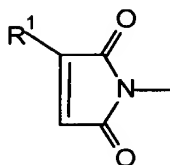


What is claimed is:

1. A curable adhesive composition for use in bonding an electronic component to a substrate comprising a maleimide compound and a curing initiator selected from the group consisting of a free-radical initiator, a photoinitiator, and a combination of those, the maleimide compound having the formula $[M-X]_n-Q$ in which m is 0 or 1 and n is 1 to 6, and

(a) M is a maleimide moiety having the structure:

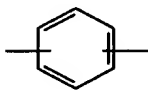


in which R¹ is H or an alkyl group having 1 to 5 carbon

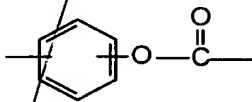
atoms;

(b) X is an aromatic group selected from the group of aromatic groups having the structures:

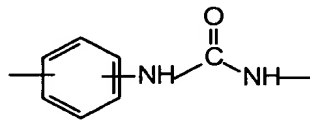
(I)



(II)

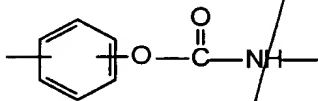


(III)



and

(IV)



and

(c) Q is a linear or branched chain alkyl, alkyloxy, alkyl amine, alkyl sulfide, alkylene, alkyleneoxy, alkylene amine, alkylene sulfide, aryl, aryloxy, or aryl sulfide species, which may contain saturated or unsaturated cyclic or heterocyclic substituents pendant from the chain or as part of the chain, and in which any heteratom present may or may not be directly

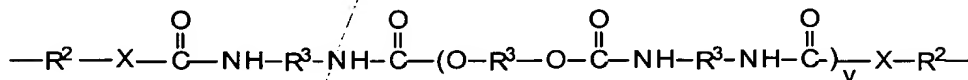
Sal
amt

attached to X.

2. The curable adhesive composition according to claim 1 in which Q is a linear or branched chain alkyl, alkyloxy, alkylene, or alkyleneoxy species, which may contain saturated or unsaturated cyclic or heterocyclic substituents pendant from the chain or as part of the chain.

3. The curable adhesive composition according to claim 2 in which Q is a linear or branched chain alkyl species, which may contain saturated or unsaturated cyclic or heterocyclic substituents pendant from the chain or as part of the chain.

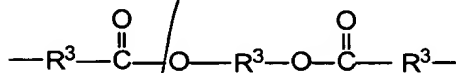
4. The curable adhesive composition according to claim 1 in which Q is a urethane having the structure:



Sal
A2

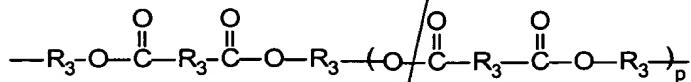
in which each R² independently is an alkyl, aryl, or arylalkyl group having 1 to 18 carbon atoms; R³ is an alkyl or alkyloxy chain having up to 100 atoms in the chain, which chain may contain aryl substituents; X is O, S, N, or P; and v is 0 to 50.

5. The curable adhesive composition according to claim 1 in which Q is an ester having the structure:



in which R³ is an alkyl or alkyloxy chain having up to 100 atoms in the chain, which chain may contain aryl substituents.

6. The curable adhesive composition according to claim 1 in which Q is an ester having the structure:



5 in which

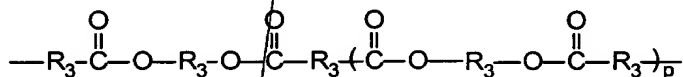
p is 1 to 100, and

each R³ can independently be an alkyl or alkyloxy chain having up to 100 atoms in the chain, which chain may contain aryl substituents; or

10 each R³ can independently be a siloxane having the structure — (CR¹₂)_e—[SiR⁴₂—O]_f—SiR⁴₂—(CR¹₂)_g— in which the R¹ substituent independently for each position is H or an alkyl group having 1 to 5 carbon atoms, the R⁴ substituent independently for each position is an alkyl group having 1 to 5 carbon atoms or an aryl group, e and g are independently 1 to 10, and f is 1 to 50.

15

7. The curable adhesive composition according to claim 1 in which Q is an ester having the structure:



in which

20

p is 1 to 100, and

each R³ can independently be an alkyl or alkyloxy chain having up to 100 atoms in the chain, which chain may contain aryl substituents; or

25 each R³ can independently be a siloxane having the structure — (CR¹₂)_e—[SiR⁴₂—O]_f—SiR⁴₂—(CR¹₂)_g— in which the R¹ substituent independently for each position is H or an alkyl group having 1 to 5 carbon atoms, the R⁴ substituent independently for each position is an alkyl group having 1 to 5

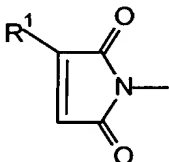
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cm

carbon atoms or an aryl group, e and g are independently 1 to 10.

50.

8. A curable adhesive composition comprising a monofunctional compound and a curing initiator selected from the group consisting of a radical initiator, a photoinitiator, and a combination of those, the monofunctional compound having the formula $[M-Z_m]_n-K$ in which m is 0 or 1 and n is 1 to 100 and

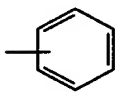
(a) M is a maleimide moiety having the structure



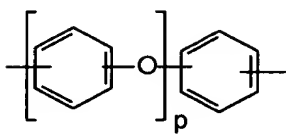
in which R¹ is H or an alkyl having 1 to 5 carbon atoms

(b) K is an aromatic group selected from group of aromatic groups having the structures:

(V)

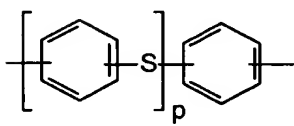


(VI)



in which p is 1 to 100;

(VII)

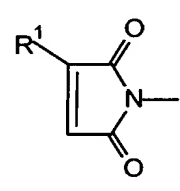


in which p is 1 to 100;

X8.

5

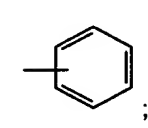
(a)



10

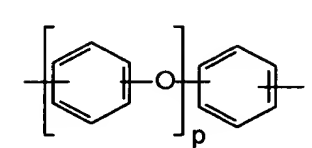
(b)

(V)



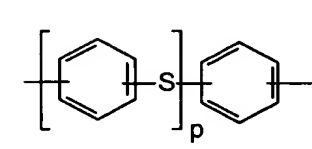
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(VI)



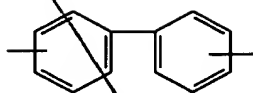
in which p is 1 to 100:

(VII)



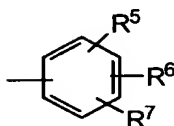
in which n is 1 to 100:

(VIII)



;

(IX)



5

in which R^5 , R^6 , and R^7 are a linear or branched chain alkyl, alkyloxy, alkyl amine, alkyl sulfide, alkylene, alkyleneoxy, alkylene amine, alkylene sulfide, aryl, aryloxy, or aryl sulfide species, which may contain saturated or unsaturated cyclic or heterocyclic substituents pendant from the chain or as part of the backbone in the chain, and in which any

10

heteratom present may or may not be directly attached to the aromatic ring;

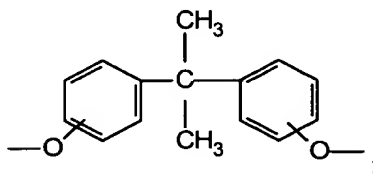
or R^5 , R^6 , and R^7 are a siloxane having the structure

$-(CR^1_2)_e-[SiR^4_2-O]_f-SiR^4_2-(CH_3)_g-$ in which the R^1 substituent is H or an alkyl group having 1 to 5 carbon atoms and the R^4 substituent independently for each position is an alkyl group having 1 to 5 carbon atoms or an aryl

15

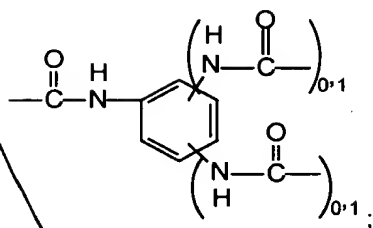
group, and e is 1 to 10 and f is 1 to 50;

(X)

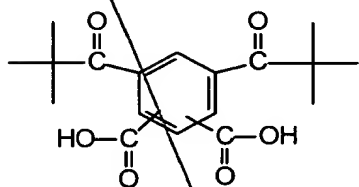


;

(XI)



(XII)



5

and

(c) Z is a linear or branched chain alkyl, alkyloxy, alkyl amine, alkyl sulfide, alkylene, alkyleneoxy, alkylene amine, alkylene sulfide, aryl, aryloxy, or aryl sulfide species, which may contain saturated or unsaturated cyclic or heterocyclic substituents pendant from the chain or as part of the chain, and in which any heteroatom present may or may not be directly attached to K.

10

9. The curable adhesive composition according to claim 8 in which Z is a linear or branched chain alkyl, alkyloxy, alkylene, or alkyleneoxy species, which may contain saturated or unsaturated cyclic or heterocyclic substituents pendant from the chain or as part of the chain.

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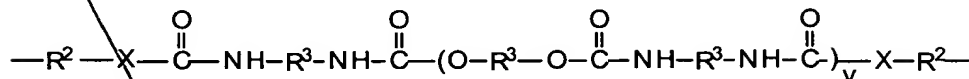
10. The curable adhesive composition according to claim 8 in which Z is a linear or branched chain alkyl species, which may contain

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558T90" 5429E60

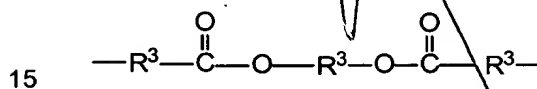
saturated or unsaturated cyclic or heterocyclic substituents pendant from the chain or as part of the chain.

11. The curable adhesive composition according to claim 8 in which Z is a urethane having the structure:



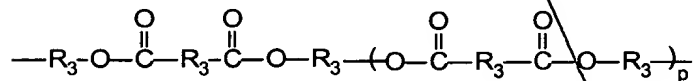
in which each R² independently is an alkyl, aryl, or arylalkyl group having 1 to 18 carbon atoms; R³ is an alkyl or alkyloxy chain having up to 100 atoms in the chain, which chain may contain aryl substituents; X is O, S, N, or P; and v is 0 to 50.

12. The curable adhesive composition according to claim 8 in which Z is an ester having the structure:



in which R³ is an alkyl or alkyloxy chain having up to 100 atoms in the chain, which chain may contain aryl substituents.

13. The curable adhesive composition according to claim 8 in which Z is an ester having the structure:



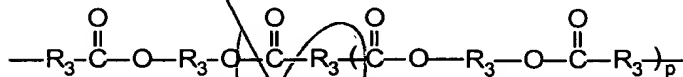
in which

p is 1 to 100, and

each R³ can independently be an alkyl or alkyloxy chain having up to 100 atoms in the chain, which chain may contain aryl substituents; or

each R³ can independently be a siloxane having the structure —
 (CR¹₂)_e—[SiR⁴₂—O]_f—SiR⁴₂—(CR¹₂)_g— in which the R¹ substituent independently
 for each position is H or an alkyl group having 1 to 5 carbon atoms, the R⁴
 substituent independently for each position is an alkyl group having 1 to 5
 carbon atoms or an aryl group, e and g are independently 1 to 10, and f is 1 to
 50.

14. The curable adhesive composition according to claim 8 in
 which Z is an ester having the structure:



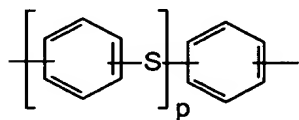
in which

p is 1 to 100, and

each R³ can independently be an alkyl or alkyloxy chain having up to
 100 atoms in the chain, which chain may contain aryl substituents; or

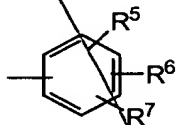
each R³ can independently be a siloxane having the structure —
 (CR¹₂)_e—[SiR⁴₂—O]_f—SiR⁴₂—(CR¹₂)_g— in which the R¹ substituent independently
 for each position is H or an alkyl group having 1 to 5 carbon atoms, the R⁴
 substituent independently for each position is an alkyl group having 1 to 5
 carbon atoms or an aryl group, e and g are independently 1 to 10, and f is 1 to
 50.

15. The curable adhesive composition according to any one of
 claims 8 to 14 in which K is



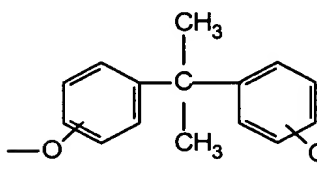
in which p is 1 to 100.

16. The curable adhesive composition according to any one of claims 8 to 14 in which K is

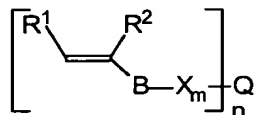


in which R⁵, R⁶, and R⁷ are a linear or branched chain alkyl, alkyloxy, alkyl amine, alkyl sulfide, alkylene, alkyleneoxy, alkylene amine, alkylene sulfide, aryl, aryloxy, or aryl sulfide species, which may contain saturated or unsaturated cyclic or heterocyclic substituents pendant from the chain or as part of the chain, and in which any heteroatom present may or may not be directly attached to the aromatic ring.

17. The curable adhesive composition according to any one of claims 8 to 14 in which K is



18. A curable adhesive composition comprising a vinyl compound and a curing initiator selected from the group consisting of a free-radical initiator, a photoinitiator, and a combination of those, the vinyl compound having the formula



in which m is 0 or 1 and n is 1-6; and

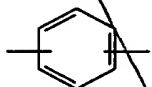
(a) R¹ and R² are H or an alkyl group having 1 to 5 carbon atoms, or together form a 5 to 9 membered ring with the carbons forming the vinyl group;

(b) B is C, S, N, O, C(O), C(O)NH or C(O)N(R⁸), in which R⁸ is an alkyl group having 1 to 5 carbon atoms;

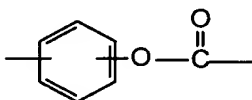
(c) X is an aromatic group selected from the group of aromatic groups having the structures:

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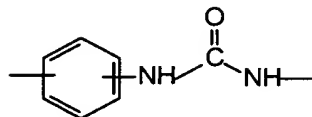
(I)



(II)

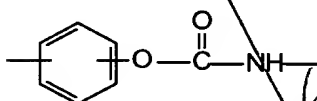


(III)



and

(IV)



; and

10

(d) Q is a linear or branched chain alkyl, alkyloxy, alkyl amine, alkyl sulfide, alkylene, alkyleneoxy, alkylene amine, alkylene sulfide, aryl, aryloxy, or aryl sulfide species, which may contain saturated or unsaturated cyclic or heterocyclic substituents pendant from the chain or as part of the chain, and in which any heteratom present may or may not be directly attached to X.

15

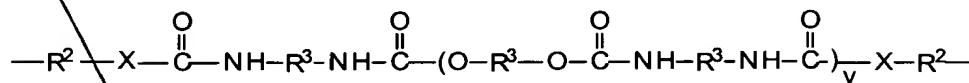
19. The curable adhesive composition according to claim 18 in which Q is a linear or branched chain alkyl, alkyloxy, alkylene, or alkyleneoxy species, which may contain saturated or unsaturated cyclic or heterocyclic substituents pendant from the chain or as part of the chain.

20

20. The curable adhesive composition according to claim 19 in which Q is a linear or branched chain alkyl species, which may contain saturated or unsaturated cyclic or heterocyclic substituents pendant from the chain or as part of the chain.

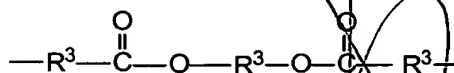
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21. The curable adhesive composition according to claim 18 in which Q is a urethane having the structure:



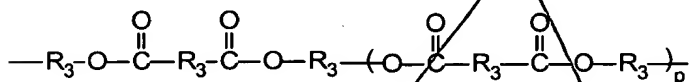
5 in which each R² independently is an alkyl, aryl, or arylalkyl group having 1 to 18 carbon atoms; R³ is an alkyl or alkyloxy chain having up to 100 atoms in the chain, which chain may contain aryl substituents; X is O, S, N, or P; and v is 0 to 50.

10 22. The curable adhesive composition according to claim 18 in which Q is an ester having the structure:



in which R³ is an alkyl or alkyloxy chain having up to 100 atoms in the chain, which chain may contain aryl substituents.

15 23. The curable adhesive composition according to claim 18 in which Q is an ester having the structure:

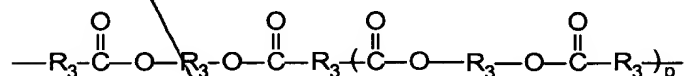


in which

20 p is 1 to 100, and
each R³ can independently be an alkyl or alkyloxy chain having up to 100 atoms in the chain, which chain may contain aryl substituents; or
each R³ can independently be a siloxane having the structure —
(CR¹₂)_e—[SiR⁴₂—O]_f—SiR⁴₂—(CR¹₂)_g— in which the R¹ substituent independently
25 for each position is H or an alkyl group having 1 to 5 carbon atoms, the R⁴

substituent independently for each position is an alkyl group having 1 to 5 carbon atoms or an aryl group, e and g are independently 1 to 10, and f is 1 to 50.

- 5 24. The curable adhesive composition according to claim 18 in which Q is an ester having the structure:



in which

p is 1 to 100, and

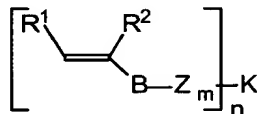
- 10 each R³ can independently be an alkyl or alkyloxy chain having up to 100 atoms in the chain, which chain may contain aryl substituents; or

each R³ can independently be a siloxane having the structure ---

(CR¹)_e---[SiR⁴₂---O]_f---SiR⁴₂---(CR¹)_g--- in which the R¹ substituent independently

- 15 for each position is H or an alkyl group having 1 to 5 carbon atoms, the R⁴ substituent independently for each position is an alkyl group having 1 to 5 carbon atoms or an aryl group, e and g are independently 1 to 10, and f is 1 to 50.

- 20 25. A curable adhesive composition comprising a vinyl compound and a curing initiator selected from the group consisting of a free-radical initiator, a photoinitiator, and a combination of those, the vinyl compound having the formula



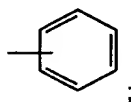
in which m is 0 or 1 and n is 1-6; and

(a) R^1 and R^2 are H or an alkyl group having 1 to 5 carbon atoms, or together form a 5 to 9 membered ring with the carbons forming the vinyl group;

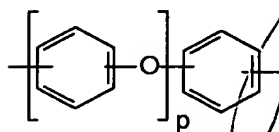
(b) B is C, S, N, O, C(O), C(O)NH or C(O)N(R^8), in which R^8 is an alkyl group having 1 to 5 carbon atoms;

(c) K is an aromatic group selected from the group of aromatic groups having the structures:

(V)

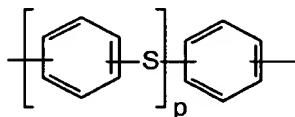


(VI)



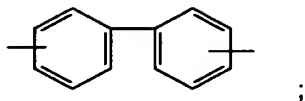
in which p is 1 to 100;

(VII)

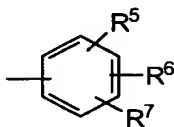


in which p is 1 to 100;

(VIII)



(IX)

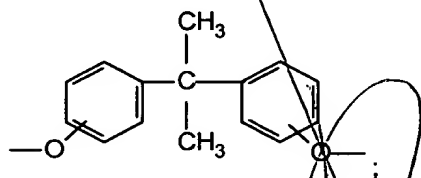


in which R^5 , R^6 , and R^7 are a linear or branched chain alkyl, alkyloxy, alkyl amine, alkyl sulfide, alkylene, alkyleneoxy, alkylene

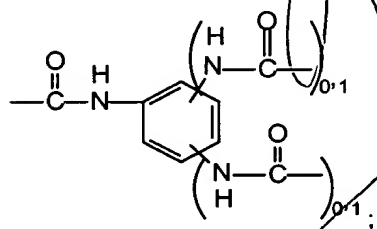
amine, alkylene sulfide, aryl, aryloxy, or aryl sulfide species, which may contain saturated or unsaturated cyclic or heterocyclic substituents pendant from the chain or as part of the backbone in the chain, and in which any heteroatom present may or may not be directly attached to the aromatic ring; or

5 R^5 , R^6 , and R^7 are a siloxane having the structure $-(CR^1_2)_e-[SiR^4_2-O]_f-SiR^4_2-(CH_3)_g-$ in which the R^1 substituent is H or an alkyl group having 1 to 5 carbon atoms and the R^4 substituent independently for each position is an alkyl group having 1 to 5 carbon atoms or an aryl group, and e is 1 to 10 and f is 1 to 50;

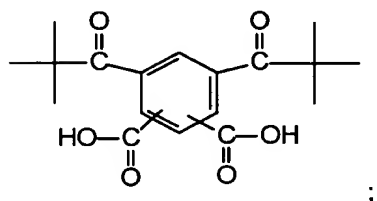
10 (X)



(XI)



15 and (XII)



and

(d) Z is a linear or branched chain alkyl, alkyloxy, alkyl amine, alkyl sulfide, alkylene, alkyleneoxy, alkylene amine, alkylene sulfide, aryl,

aryloxy, or aryl sulfide species, which may contain saturated or unsaturated cyclic or heterocyclic substituents pendant from the chain or as part of the chain, and in which any heteratom present may or may not be directly attached to X.

5

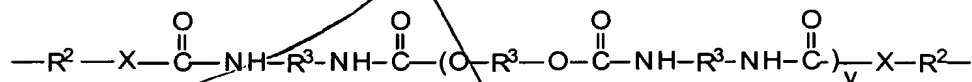
26. The curable adhesive composition according to claim 25 in which Z is a linear or branched chain alkyl, alkyloxy, alkylene, or alkyleneoxy species, which may contain saturated or unsaturated cyclic or heterocyclic substituents pendant from the chain or as part of the chain.

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27. The curable adhesive composition according to claim 25 in which Z is a linear or branched chain alkyl species, which may contain saturated or unsaturated cyclic or heterocyclic substituents pendant from the chain or as part of the chain.

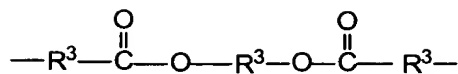
15

28. The curable adhesive composition according to claim 25 in which Z is a urethane having the structure:



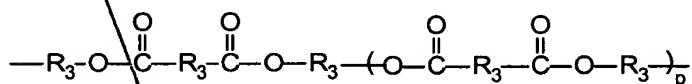
20 in which each R² independently is an alkyl, aryl, or arylalkyl group having 1 to 18 carbon atoms; R³ is an alkyl or alkyloxy chain having up to 100 atoms in the chain, which chain may contain aryl substituents; X is O, S, N, or P; and v is 0 to 50.

25 29. The curable adhesive composition according to claim 25 in which Z is an ester having the structure:



in which R^3 is an alkyl or alkyloxy chain having up to 100 atoms in the chain, which chain may contain aryl substituents.

- 5 30. The curable adhesive composition according to claim 25 in which Z is an ester having the structure:



in which

p is 1 to 100, and

- 10 each R^3 can independently be an alkyl or alkyloxy chain having up to 100 atoms in the chain, which chain may contain aryl substituents; or

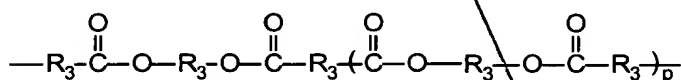
each R^3 can independently be a siloxane having the structure —

$(CR^1_2)_e-[SiR^4_2-O]_f-SiR^4_2-(CR^1_2)_g-$ in which the R^1 substituent independently

for each position is H or an alkyl group having 1 to 5 carbon atoms, the R^4

- 15 substituent independently for each position is an alkyl group having 1 to 5 carbon atoms or an aryl group, e and g are independently 1 to 10, and f is 1 to 50.

- 20 31. The curable adhesive composition according to claim 25 in which Z is an ester having the structure:

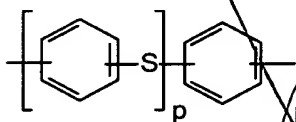


in which p is 1 to 100, and

each R^3 can independently be an alkyl or alkyloxy chain having up to 100 atoms in the chain, which chain may contain aryl substituents; or

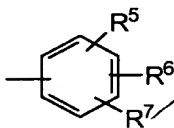
each R³ can independently be a siloxane having the structure —
 (CR¹₂)_e—[SiR⁴₂—O]_f—SiR⁴₂—(CR¹₂)_g— in which the R¹ substituent independently
 for each position is H or an alkyl group having 1 to 5 carbon atoms, the R⁴
 substituent independently for each position is an alkyl group having 1 to 5
 5 carbon atoms or an aryl group, e and g are independently 1 to 10, and f is 1 to
 50.

32. The curable adhesive composition according to any one of
 claims 25 to 31 in which K is



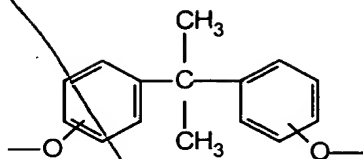
when p is 1 to 100.

33. The curable adhesive composition according to any one of
 claims 25 to 31 in which K is



in which R⁵, R⁶, and R⁷ are a linear or branched
 15 chain alkyl, alkyloxy, alkyl amine, alkyl sulfide, alkylene, alkyleneoxy, alkylene
 amine, alkylene sulfide, aryl, aryloxy, or aryl sulfide species, which may
 contain saturated or unsaturated cyclic or heterocyclic substituents pendant
 from the chain or as part of the chain, and in which any heteroatom present
 may or may not be directly attached to the aromatic ring.

20 34. The curable adhesive composition according to any one of
 claims 25 to 31 in which K is



35. A curable adhesive composition comprising a maleimide compound as described in any one of claims 1 to 17 and a vinyl compound as described in any one of claims 18 to 34, and a curing initiator.

36. A curable adhesive composition comprising a maleimide compound as described in any one of claims 1 to 17, or a vinyl compound as described in any one of claims 18 to 34, or a combination of a maleimide compound as described in any one of claims 1 to 17 and a vinyl compound as described in any one of claims 18 to 34, and an anionic or cationic curing initiator.

37. An electronic assembly comprising an electronic component bonded to a substrate with a cured adhesive composition prepared from a composition according to ~~any one of the preceding claims.~~ *claim 1.*